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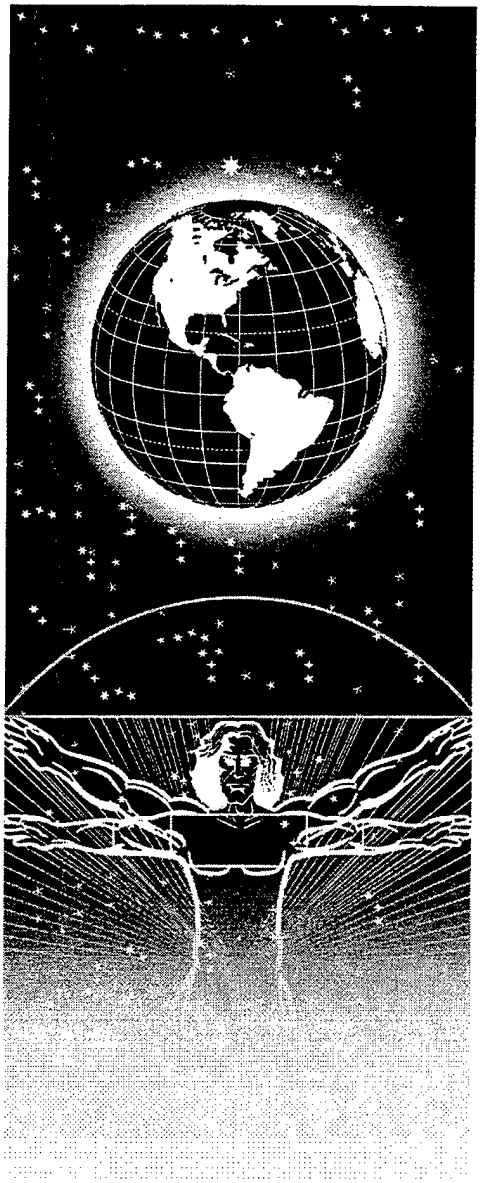

UNITED STATES AIR FORCE
ARMSTRONG LABORATORY

USING THE NEO-PI-R TO ASSESS THE PERSONALITY OF US AIR FORCE PILOTS

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The Office of Public Affairs has reviewed this technical report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This technical report has been reviewed and is approved for publication.

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The study of pilot personality has a long and controversial history. Personality characteristics are fairly poor predictors of training completion, but are probably better predictors of operational performance. Personality characteristics are also important considerations in clinical psychological assessment. The current paper describes the personality characteristics of 1301 US Air Force students pilots based on the NEO Personality Inventory (NEO-PI-R). Compared to male adult norms, male student pilots had higher levels of extraversion and lower levels of agreeableness. Compared to female adult norms, female student pilots had higher levels of extraversion and higher levels of openness as well as lower levels of agreeableness. Percentile tables for the five domain scores and 30 facet scales are provided and discussed for clinical use. A case study is also provided as an example of the clinical utility of these US Air Force norms.

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PREFACE

This project was made possible by support from the Air Force Medical Operating Agency, Armstrong Laboratory, and the AFOSR Summer Faculty Research Program.

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USING THE NEO-PI-R TO ASSESS THE PERSONALITY OF US AIR FORCE PILOTS

SUMMARY

The study of pilot personality has a long and controversial history. Personality characteristics are fairly poor predictors of training completion, but are probably better predictors of operational performance. Personality characteristics are also important considerations in clinical psychological assessment. The current paper describes the personality characteristics of 1301 US Air Force student pilots based on the NEO Personality Inventory (NEO-PI-R). Compared to male adult norms, male student pilots had higher levels of extraversion and lower levels of agreeableness. Compared to female adult norms, female student pilots had higher levels of extraversion and higher levels of openness as well as lower levels of agreeableness. Percentile tables for the five domain scores and 30 facet scales are provided and discussed for clinical use. A case study is also provided as an example of the clinical utility of these US Air Force norms.

INTRODUCTION

Background

Psychologists first measured pilots' personality characteristics during World War I, and even at that time there were starkly divergent ideas about which personality characteristics were most important. For example, Rippon and Manuel (1918) described the ideal pilot as high-spirited and happy-go-lucky, while Dockery and Isaacs (1921) described the ideal pilot as quiet and methodical. The controversy over pilot personality continues today, driven primarily by strong evidence that personality measures are poor predictors of completion of initial training (Hunter & Burke, 1995). On the other hand, personality measures may have more utility in predicting performance beyond initial training completion. For example, Houston (1988) found that personality measures were the best predictors of the ratings given to first officers by captains in commercial airlines. Similarly, personality characteristics appear to significantly impact training in crew resource management (Chidester, Helmreich, Gregorich, & Geis, 1991). Moreover, personality measures taken during initial training appear to predict retention characteristics in US Air Force pilots (Retzlaff, King & Callister, 1995).

In addition to occupational issues, the assessment of personality is an essential part of the clinical evaluation of pilots. Despite the controversy over the relationship between "normal" personality characteristics and pilot performance, there is little argument that there are "abnormal" personality characteristics which are undesirable. Highly anxious, hostile, or impulsive pilots probably should not fly. In the US Air Force, personality disorders are not medically disqualifying; however, administrative action can occur when

personality characteristics are judged to significantly impair the performance of military duties (AFI 48-123). Also, US Air Force flight surgeons are required to judge aircrew applicants' suitability for flying duty during initial selection physical examinations through a process known as the ARMA (Adaptability Rating for Military Aeronautics). The ARMA typically involves an assessment of motivation, insight, past accomplishments, and social poise (Mills & Jones, 1984). Identified problems in these areas warrant further psychological evaluation. Verdone, Sipes, and Miles (1993) describe a number of limitations in the ARMA as a screening tool, and report that flight surgeons would like better training, guidance, and more objective methods of evaluating potential pilots.

Currently, US Air Force psychologists use standardized personality measures such as the Minnesota Multiphasic Personality Inventory (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1991) and the Millon Clinical Multiaxial Inventory (MCMI-III; Millon, 1994) when conducting clinical psychological assessments of pilots (AFI 48-123). These tests have been shown to be reliable and valid measures of personality and have been normed based on the general population. Several studies demonstrate that pilots, as a group, differ from the general population, and for this reason experienced aviation psychologists use pilot-based normative data whenever possible (Retzlaff & Gibertini, 1988; Retzlaff & Gibertini, 1987). Appropriate pilot norms are difficult to establish since these tests are rarely given to large representative samples of pilots.

Many previous authors have suggested that the average pilot is more extroverted and independent than someone from the general population. Some of this is based on pilot lore, most recently depicted in the popular culture by such films as *The Right Stuff*, *The Great Santini,* and *Top Gun*, and some is based on the many studies of pilot personality designed to improve pilot selection techniques. Large studies using reliable, valid, and relevant tests are rare. This is particularly true with regard to female pilots, with the exception of Novello and Yousef (1974) and more recently King, Retzlaff, and McGlohn (in press).

There are several distinct types of personality inventories. These measures of personality differ depending on the purpose for which they were developed. For example, tests such as the MMPI and the MCMI were designed to identify psychopathology, while measures such as the NEO-PI-R were designed to describe normal personality characteristics. Both types of tests overlap to some degree, but the distinction is important because testing for psychopathology has been shown to be of limited value in assessment of the high functioning pilot population (King, 1994). On the other hand, measures of normal personality characteristics can be used to establish a baseline of data for later use should problems arise (Callister, King, Lanier, & Etterle, 1995). Additionally, a popular current theory holds that five factors represent the most basic dimensions of personality and measures such as the NEO-PI-R have been shown to be useful for both clinical and research applications (Costa & McRae, 1992).

Purpose

The purpose of this paper is first to describe the personality characteristics of US Air Force student pilots based upon the results of the NEO-PI-R. Second, normative data suitable for use in the evaluation of pilots will be provided and clinically applied.

METHOD

Subjects

A sample of 1301 US Air Force student pilots participated in this study. This sample included 1198 male student pilots and 103 female student pilots. The mean age was 22.6 (SD = 2.9). Approximately 56% of the sample were college graduates who had received or would receive a commission through Officer Training School, Reserve Officer Training Corps, the Air National Guard, or the AF Reserve. The others were in their third year at the United States Air Force Academy.

Instrument

The NEO-PI-R is a test designed to measure normal personality characteristics. It consists of 240 statements to which the evaluee responds on a scale from 1 to 5 which represents "strongly disagree," "disagree," "neutral," "agree," or "strongly agree." The test is not timed. Participants generally took from 30 to 40 minutes to complete the test. For this study, the computer-administered version of the NEO-PI-R was used. This version produces a standardized set of instructions and scores the test automatically. Scored NEO-PI-R's provide five domain scores (*Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness*) and six facet scores under each domain. Table 1 lists the names of all domain and facet scores. Each participant's scores were compared with the appropriate sex norms from the general adult population. Reliabilities for Facet Scores ranged from .56 to .92 and reliabilities for domain scores ranged from .86 to .95. The validity of the NEO-PI-R has been evaluated extensively and is summarized in the test manual (Costa & McCrae, 1992).

Procedure

Prior to entering the Enhanced Flight Screening (EFS) Programs at Hondo, TX and the US Air Force Academy in Colorado Springs, CO, student pilots participate in baseline psychological testing. Tests of intelligence, cognitive abilities and personality characteristics are given to each student in addition to the NEO-PI-R. Students are required to take the intelligence and cognitive abilities tests to continue through the screening process (King & Flynn, 1995; Callister, King, & Retzlaff, 1996; Callister, King, & Retzlaff, 1995; Callister and Retzlaff, 1996; Retzlaff, Callister, & King, 1996). Tests of personality characteristics which include the NEO-PI-R and the Armstrong Laboratory

Aviation Personality Survey (Retzlaff, King, McGlohn, & Callister, 1996) are optional with the student able to decline without consequence. During the testing process, student pilots were asked to consent to allow their testing data to be used for research, and approximately 96% (N=1301) chose to participate.

RESULTS

Table 2 provides the means and standard deviations for the total sample of student pilots. Table 2 also includes percentiles which were derived by applying the mean scale score to the NEO manual percentile norm tables. As such, the percentiles represent the mean student pilot scores in the context of general population norms. For example, the mean *Extraversion* score of 126.31 corresponds with the 83rd percentile of general population norms which suggests that as a group student pilots are more extraverted than the general population.

As can be seen in Table 2, as a group, student pilots scored higher on the *Extraversion* and *Openness* domains, and scored lower on the *Agreeableness* domain. As expected, most facet scores correspond with their domain score. For example, five of six *Extraversion* facet scores are elevated. There are, however, some interesting exceptions. For example, although the *Agreeableness* domain score and five of six facet scores are low, the *Altruism* facet is in the average range. Although the *Conscientiousness* domain score is average, the facets of *Competence*, *Dutifulness*, and *Achievement Striving* are high. Also, while the *Neuroticism* domain score and five of six facet scores are average, the *Vulnerability* facet score is very low.

Table 3 provides the means, standard deviations, and percentiles for the sample of 1198 male student pilots. *Extraversion* domain scores are high and *Agreeableness* domain scores are low. Facet scores are very similar to the facet scores described above for the entire sample. This result is not unexpected since men make up such a large portion of the entire sample.

Table 4 provides the means, standard deviations, and percentiles for the sample of 103 female student pilots. Similar to male student pilots, *Extraversion* domain scores are high and *Agreeableness* domain scores are low. Unlike male student pilots, *Openness* domain scores are high compared with the general female population. Also not true for male pilots, *Self-Consciousness* and *Modesty* facet scores are low compared with the general population.

Table 5 provides the percentile levels for each of the NEO-PI-R scales for the male student pilots. Table 6 provides the percentile levels for the female student pilots. Both tables list actual percentile levels, not percentiles derived from means and standard deviations. These tables can be used to make specific comparisons with the current samples. For example, a male student pilot with a *Conscientiousness* score of 158 would

be at the 95th percentile of the current male sample, or a female student pilot with a *Neuroticism* score of 40 would be at the 5th percentile of the current female sample.

DISCUSSION AND CLINICAL APPLICATION

The current work has shown that the average male student pilot is more extraverted and less agreeable than men in the general population. He is more assertive, active, and excitement-seeking, and describes himself as more competent and achievement striving and less vulnerable then men in the general population. The average female student pilot is also more extraverted and less agreeable than women in the general population. In addition, she is more open to new ideas, emotions, actions and creative thought. Similar to the average male student pilot, she is more assertive, active, excitement-seeking, and achievement striving; however, she is much less likely to be socially compliant than women in the general population. Such a finding is not surprising considering that flying a military aircraft is counter to traditional feminine roles.

For clinical purposes, the percentile tables in this study are central. While premorbid data, such as that available from screening programs like EFS, is the most useful, data from large data sets such as this study may be used to put an individual's NEO-PI-R scores into the context of scores from US Air Force student pilots. The percentile tables give specific percentiles for specific scores. Scores which fall above the 95th or below the 5th percentile can be viewed as significantly different from this US Air Force sample.

An example of the utility of this data would be the case of a student pilot who was referred to the wing's aviation clinical psychologist for an evaluation to rule out Manifestations of Apprehension (MOA). MOA is the student pilot equivalent of Fear of Flying in a trained pilot. In other words, it is a non-phobic fear associated with flying which significantly impairs a flyer's ability to perform effectively. This particular student was described as performing below average in general, and performing particularly poorly when under pressure in the cockpit. In cases such as this one, it is important to distinguish lack of ability from lack of motivation. Also, it is important to identify the presence of any medically disqualifying condition, such as an anxiety disorder (American Psychiatric Association, 1994). In this case, the student had taken the NEO-PI-R during the medical screening phase of the Enhanced Flight Screening Program. A review of his pre-training NEO-PI-R data showed that he had an average *Neuroticism* domain score (near 50th percentile). Subscales under this domain were also not elevated with average *Anxiety*, *Depression*, and *Vulnerability* facet scores (all between the 15th and 50th percentiles). This argues against a premorbid anxiety or mood disorder. Further, he had a very low *Achievement Striving* facet score of 9 (raw) which placed him at the 1st percentile (see Table 5) of the pilot sample. This left open the possibility of inadequate motivation. The student's primary instructor pilot (IP) stated he believed the student was capable of completing training, but seemed to "quickly get behind under stressful situations." The IP

also described the student as a "nice guy," but went on to say the student did not seem to fit in well with others in the flight. General lack of capability is not likely, given the IP's appraisal and the baseline cognitive ability data collected prior to training (Callister, King, & Retzlaff, 1996; Retzlaff, Callister, & King, 1996; Callister, King, & Retzlaff, 1995). Clinical interview revealed a self-description not consistent with a flying related anxiety with the denial of symptoms such as increased physiological arousal or specific avoidance behavior. However, the student had been considering alternative career options. After two brief visits over two days, the student decided to eliminate himself from training and subsequently cross-trained into another, probably more appropriate, career field. In this case, NEO-PI-R data was used to compare this student with specific male student pilot norms. These comparisons contributed to the psychologist's accurate assessment and brief intervention.

This study used a fairly large sample as well as a reliable and valid measure of personality. There are, however, limitations to the generalizability of this data. First, the subjects in this study were all student pilots. Approximately 17% do not become rated pilots, and the attrition rate for men and women may not be equal. Second, the subjects were all US Air Force Officers, so generalizing to other populations should be done with caution. For example, generalizing to US Naval aviators probably is appropriate. Generalizing to US Army aviators should be done only with considerable care since many US Army aviators are Warrant Officers, many without college education. Generalizing to student pilots in general aviation settings is discouraged since education levels, age, socio-economic status and many other variables differ considerably. Although further study of these other groups is critical, until such time as data from such additional studies becomes available, use of this data along with general norms for clinical purposes may be a good conservative course.

In summary, pilots are valuable personnel assets which must be provided the highest level of psychological services. Valid psychological assessment is a critical step in this process. Previous work in the area of psychological assessment of pilots has focused mainly on personnel selection and not on clinical evaluation. The present study demonstrates how large studies using reliable, valid, and clinically relevant tests can yield the type of data necessary to improve the psychological services available to the flying community.

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Table 1

Domains and Facets Measured by the NEO-PI-R.

Domains	Facets
Neuroticism	
	Anxiety
	Angry Hostility
	Depression
	Self-Consciousness
	Impulsiveness
	Vulnerability
Extraversion	
	Warmth
	Gregariousness
	Assertiveness
	Activity
	Excitement Seeking
	Positive Emotions
Openness	
	Fantasy
	Aesthetics
	Feelings
	Actions
	Ideas
	Values
Agreeableness	
	Trust
	Straightforwardness
	Altruism
	Compliance
	Modesty
	Tender-Mindedness
Conscientiousness	
	Competence
	Order
	Dutifulness
	Achievement Striving
	Self-Discipline
	Deliberation.

Table 2

Total Sample NEO-PI-R Descriptive Statistics.

Scale	Mean	SD	Percentile
Neuroticism	71.92	19.92	42
Anxiety	13.01	4.72	46
Angry Hostility	12.44	4.85	54
Depression	11.00	4.79	48
Self-Consciousness	13.11	4.57	45
Impulsiveness	15.25	4.69	48
Vulnerability	7.09	3.54	21*
Extraversion	126.31	18.15	83*
Warmth	22.85	4.17	50
Gregariousness	18.37	5.30	62*
Assertiveness	19.75	4.48	84*
Activity	20.84	3.82	80*
Excitement-Seeking	22.87	3.83	92*
Positive Emotions	21.61	4.54	70*
Openness	115.18	18.87	60*
Fantasy	19.20	5.18	72*
Aesthetics	17.24	5.98	48
Feelings	21.09	4.49	62*
Actions	16.70	4.02	61*
Ideas	21.82	5.27	74*
Values	19.09	4.71	38*
Agreeableness	113.32	18.49	20*
Trust	20.09	4.88	35*
Straightforwardness	18.81	4.72	30*
Altruism	23.32	3.86	48
Compliance	16.19	4.42	26*
Modesty	16.89	4.85	33*
Tender	17.99	4.10	25*
Conscientiousness	127.96	19.23	58
Competence	23.95	3.50	76*
Order	18.76	4.69	54
Dutifulness	23.64	3.80	61*
Achievement Striving	22.49	4.34	77*
Self-Discipline	21.69	4.57	52
Deliberation	17.40	4.28	47

Note: * Indicates Percentile 10% Above Or Below General Population Norms.

Table 3

Male Pilot NEO-PI-R Descriptive Statistics

Scale	Mean	SD	Percentile
Neuroticism	71.00	19.60	43
Anxiety	12.75	4.69	53
Angry Hostility	12.39	4.84	55
Depression	10.82	4.70	53
Self-Consciousness	12.99	4.54	51
Impulsiveness	15.11	4.65	51
Vulnerability	6.91	3.53	27*
Extraversion	126.13	18.01	85*
Warmth	22.77	4.13	55
Gregariousness	18.32	5.25	67*
Assertiveness	19.80	4.47	81*
Activity	20.81	3.85	82*
Excitement-Seeking	22.92	3.82	91*
Positive Emotions	21.48	4.54	66*
Openness	114.39	18.96	59
Fantasy	19.15	5.17	69*
Aesthetics	17.00	6.04	54
Feelings	20.93	4.51	67*
Actions	16.52	4.02	63*
Ideas	21.88	5.33	68*
Values	18.89	4.79	35*
Agreeableness	112.89	18.51	28*
Trust	20.05	4.83	39*
Straightforwardness	18.71	4.71	38*
Altruism	23.26	3.87	57
Compliance	16.19	4.42	30*
Modesty	16.78	4.88	43
Tender	17.88	4.15	33*
Conscientiousness	128.24	19.15	57
Competence	24.06	3.48	72*
Order	18.76	4.67	54
Dutifulness	23.72	3.74	61*
Achievement Striving	22.52	4.37	84*
Self-Discipline	21.71	4.56	51
Deliberation	17.44	4.30	44

Note: * Indicates Percentile 10% Above Or Below General Population Norms.

Table 4

Female Pilot NEO-PI-R Descriptive Statistics

Scale	Mean	SD	Percentile
Neuroticism	82.52	23.33	51
Anxiety	16.00	5.05	57
Angry Hostility	12.98	5.03	60*
Depression	13.00	5.75	58
Self-Consciousness	14.42	4.95	39*
Impulsiveness	16.94	5.17	62*
Vulnerability	9.16	3.69	37*
Extraversion	128.35	19.79	81*
Warmth	23.70	4.64	59
Gregariousness	18.95	5.82	68*
Assertiveness	19.18	4.65	80*
Activity	21.12	3.40	78*
Excitement-Seeking	22.29	3.92	91*
Positive Emotions	23.09	4.57	73*
Openness	124.32	17.81	79*
Fantasy	19.85	5.29	81*
Aesthetics	20.08	5.26	63*
Feelings	22.97	4.19	74*
Actions	18.73	3.98	75*
Ideas	21.19	4.46	74*
Values	21.47	3.54	62*
Agreeableness	118.39	18.36	23*
Trust	20.59	5.34	40
Straightforwardness	19.97	4.80	31*
Altruism	24.00	3.80	57
Compliance	16.25	4.32	21*
Modesty	18.28	4.52	35*
Tender	19.30	3.44	31*
Conscientiousness	124.70	20.17	52
Competence	22.68	3.79	68*
Order	18.82	4.95	53
Dutifulness	22.72	4.44	53
Achievement Striving	22.12	4.05	77*
Self-Discipline	21.38	4.69	42
Deliberation	16.95	4.08	50

Note: * Indicates Percentile 10% Above Or Below General Population Norms.

Table 5

Male Pilot Percentile Levels

	1%	5%	15%	50%	85%	95%	99%
Neuroticism	26	40	51	69	91	104	120
Anxiety	2	5	7	12	17	20	23
Angry Hostility	2	5	7	11	17	21	24
Depression	1	3	6	10	15	19	24
Self-Consciousness	2	5	8	12	17	20	24
Impulsiveness	4	7	10	14	20	22	25
Vulnerability	0	1	3	6	10	13	16
Extraversion	85	95	107	126	144	156	168
Warmth	11	15	18	23	26	29	31
Gregariousness	4	9	12	18	23	26	29
Assertiveness	9	12	15	19	24	26	29
Activity	10	14	16	20	24	27	29
Excitement-Seeking	13	16	19	22	27	29	31
Positive Emotions	9	13	16	21	26	28	31
Openness	68	84	95	114	134	146	158
Fantasy	7	10	13	19	24	27	30
Aesthetics	3	7	10	17	23	26	30
Feelings	9	13	16	21	25	28	30
Actions	5	10	12	16	20	23	25
Ideas	6	12	16	22	27	30	31
Values	5	9	13	19	23	26	28
Agreeableness	64	79	95	113	131	141	153
Trust	6	10	15	20	24	26	30
Straightforwardness	7	10	13	19	23	26	28
Altruism	12	16	19	23	27	29	31
Compliance	5	8	11	16	20	23	26
Modesty	5	8	11	17	21	24	27
Tender	7	10	13	18	22	24	27
Conscientiousness	74	95	109	128	147	158	168
Competence	14	18	20	24	27	29	31
Order	6	10	14	18	23	26	28
Dutifulness	13	17	20	23	27	29	31
Achievement Striving	9	14	18	22	26	28	30
Self-Discipline	9	13	17	22	26	28	31
Deliberation	6	10	12	17	21	24	27

Table 6

Female Pilot Percentile Levels

	1%	5%	15%	50%	85%	95%	99%
Neuroticism	34	46	56	80	107	127	140
Anxiety	5	8	10	16	21	24	27
Angry Hostility	1	6	8	12	18	22	27
Depression	1	4	7	12	20	24	25
Self-Consciousness	5	7	9	13	19	24	27
Impulsiveness	2	8	12	16	22	25	27
Vulnerability	2	3	5	8	12	16	18
Extraversion	83	93	104	129	150	157	164
Warmth	9	13	19	24	28	29	31
Gregariousness	5	8	12	19	25	28	30
Assertiveness	6	10	14	19	24	26	29
Activity	13	14	17	21	24	26	28
Excitement-Seeking	13	14	17	22	26	28	30
Positive Emotions	13	15	17	23	28	30	31
Openness	75	93	105	124	140	156	166
Fantasy	7	11	13	20	25	28	30
Aesthetics	4	10	13	20	25	28	30
Feelings	12	15	18	23	26	30	31
Actions	11	12	14	18	22	24	28
Ideas	10	13	16	21	25	28	30
Values	10	15	17	21	24	26	28
Agreeableness	78	83	97	118	136	144	159
Trust	5	9	15	21	25	27	31
Straightforwardness	7	11	14	20	25	27	29
Altruism	15	17	19	24	27	30	31
Compliance	4	9	11	16	20	23	25
Modesty	5	10	13	18	23	25	27
Tender	12	13	15	19	22	25	27
Conscientiousness	63	87	102	128	144	149	164
Competence	11	15	18	23	26	28	30
Order	7	9	12	19	23	25	28
Dutifulness	9	13	17	23	26	29	31
Achievement Striving	11	14	18	22	26	27	28
Self-Discipline	6	12	16	22	25	27	29
Deliberation	7	9	12	17	21	23	25